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EVALUATION OF DOW PELESPAN
MOLD-A-PAC LOOSE-FILL CUSHIONING MATERIAL

HQ AFLC/DSTZ
AIR FORCE PACKAGING EVALUATION AGENCY
WRIGHT-PATTERSON AFB, OHIO 45433-5999

MAY 1987

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AFPEA PROJECT NO: 85-P-132

TITLE: Evaluation of Pelespan Mold-A-Pac Loose-Fill Cushioning Material

ABSTRACT

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The AMC Packaging, Storage, and Containerization Center requested this agency to evaluate the new Pelespan Mold-A-Pac (MPS), loose-fill cushioning material produced by Dow Chemical Company. The addition of a latex bonding agent to the "Pelespan", loose-fill bulk material provided a possible solution to typical sifting and settling characteristics of loose-fill material. The cushioning performance of both MPS and Foam-In-Place (FIP) materials were evaluated using the free-fall drop test of FTMS 101C, Method 5007.1. The Pelespan Mold-A-Pac was found to be a more effective cushioning material than Foam-In-Place for items with relatively low static bearing stresses, i.e., .35 psi and .42 psi for two inch and four inch thicknesses, respectively. However, for items with greater static bearing stresses FIP was found to be superior over MPS in its ability to retain material integrity and cushioning performance reliability after a series of free-fall impacts. Exposure to high humidity conditions caused the MPS material to perform less effective due to the failure of the latex bonding mechanism.
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BACKGROUND

The AMC Packaging, Storage, and Containerization Center (AMCPSCC) requested the Air Force Packaging Evaluation Agency (AFPEA) to evaluate the new Pelespan Mold-A-Pac (MPS), cushioning material produced by Dow Chemical Company. The evaluation was conducted in accordance with AFPEA lead service responsibilities. This new concept in loose-fill cushioning/dunnage is primarily based on one of Dow's older products called Pelespan loose-fill cushioning material. The addition of a latex bonding agent to this material has provided a possible solution to the sifting and settling problems typically exhibited by loose-fill materials.

PURPOSE

The purpose of this project was to identify performance characteristics of MPS. Due to interest expressed by several Air Logistics Centers and AMCPSCC in finding a possible alternative to polyurethane foam-in-place (FIP) cushioning, MPS performance was compared against that of similar packs incorporating FIP cushioning.

DESCRIPTION OF TEST PACKS

Three simulated test loads, 5" x 5" x 6", 6" x 6" x 6" and 7" x 7" x 10" (Figures 1-3) consisting of a central wood block and interchangeable wood, aluminum, and steel plates were used to vary the load weight to attain the desired static stress points. Each "dummy" load was instrumented with three crystal accelerometers triaxially mounted in the central wood block. The exterior container was an RSC corrugated container fabricated from PPP-F-320, Class V3c, fiberboard. Two sizes of containers were used for each "dummy" load size to provide two and four inch cushioning protection. The interior cushioning consisted of polyurethane foam-in-place (1.0 PCF) or Pelespan Mold-A-Pac. Preparation of the FIP packs was accomplished at AFPEA using FIP material meeting MIL-F-83671, Class 2, Grade B, requirements. The dynamic cushioning quality conformance curves for the Grade B material are presented in Graph 1. The Pelespan Mold-A-Pacs were prepared by Dow Chemical USA at their Granville, Ohio facility.

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TEST EQUIPMENT AND INSTRUMENTATION

A "Gaynes" drop tester, Model 125 DTP (Figure 4), was used in performing the completed pack drop tests to determine the dynamic cushioning properties. Instrumentation used to measure these properties consisted of the following:

- a. Endevco crystal accelerometers, Model 2233E, three each.
- b. Endevco charge amplifiers, Model 2614C, three each.
- c. Endevco power supply, Model 2622C.
- d. A Tektronix four trace Storage Oscilloscope, Model 5115.

TEST PROCEDURES

The free-fall drop testing was conducted in accordance with Federal Test Method Standard 101C, Method 5007.1, Free-Fall Drop Test. The containers were dropped from a 30 inch height. The drop test procedure consisted of ten drops alternated between opposite end faces so that no face received two successive impacts. The resultants of the drops were averaged to give the peak acceleration for each static bearing stress point. Containers with MPS were also tested to determine the effects of high humidity on cushioning performance. After conditioning these containers for five days at 80 degrees F and 90 percent RH, drop tests were performed.

RESULTS

The results are presented in the attached Peak Acceleration-Static Stress curves, Graphs 2-4. The results are plotted in terms of peak Gs versus static stress (psi). Data developed for both materials of two inch thickness is presented in Graph 2. At static bearing stresses below approximately 0.35 psi, MPS was a more effective cushioning material than FIP. However, above this point FIP provided better protection. For example, at the lowest point of the static stress range (0.1 psi) the shock protection provided by MPS was 50 Gs as compared to 80 Gs for FIP. For the portion of the static stress range above .35 psi, FIP material provides approximately 15-20 percent better protection than MPS. Inspection of the containers after 10 drops indicated no rotation or degradation of the FIP material. Loads with bearing stresses exceeding .80 psi, did however, cause the FIP to take a compression set. The MPS showed signs of sifting and settling as indicated by rotation of the load.

Comparison of the performance of the materials of four inch thickness is presented in Graph 3. At static bearing stresses below approximately 0.40 psi, MPS was a more effective cushioning material than FIP. Above .40 psi, the FIP material provides a moderate 10-15 percent improvement in protection over MPS. Inspection of the FIP containers after the drops, again indicated no rotation of the simulated loads or degradation of the cushioning material. The MPS material, however, was fractured with the simulated load rotating and migrating through the material.

Since there was a possibility of disturbing the integrity of the MPS material during testing, the containers were not opened to determine at what point in the drop test cycle the material began to fracture. For this reason several additional uninstrumented containers were evaluated to specifically determine when material fracture occurred. It was determined that material fracture occurred after 6-8 drops for the two and four inch material thicknesses at static bearing stresses of 0.35 and 0.42 psi, respectively.

Graph 4 presents the data collected on MPS subjected to 90 percent relative humidity (RH). A total of eight containers were evaluated; four each of two inch and four inch MPS material. Both thicknesses of MPS provided an average of 10-15 percent lesser protection than the containers evaluated at normal room conditions (70 degrees F, 50% RH). The loss in performance was attributed to the solubility of the latex adhesive material with water. At the higher humidity levels the bonding system broke down causing the simulated load to settle, rotate, and sift through the MPS material.

CONCLUSION

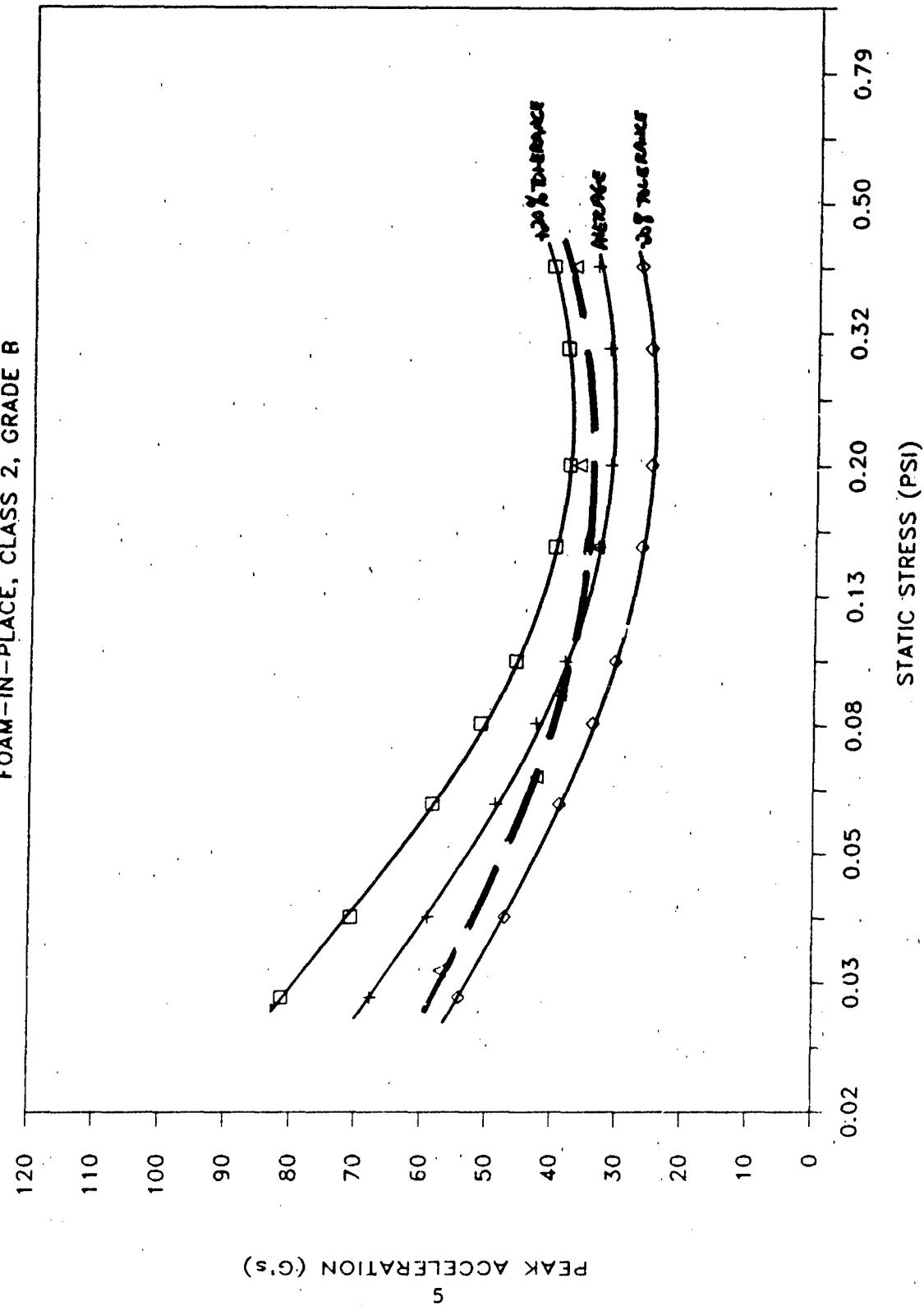
Pelespan Mold-A-Pac is a more effective cushioning material than polyurethane foam-in-place for items with relatively low static bearing stresses, i.e., static bearing stresses less than .35 psi and .42 psi for two inch and four inch thicknesses, respectively. These static stress points were determined to be fracture points for MPS. Static bearing stresses above these respective points caused the material to lose its adhesive bound integrity, particularly during multiple impacting. When this occurs the material then begins to perform as a typical loose-fill cushioning material.

At static stresses above .35 psi-.42 psi, FIP is a more effective cushioning material than MPS and exhibits a better ability to retain material integrity and reliability after repeated free-fall impacts.

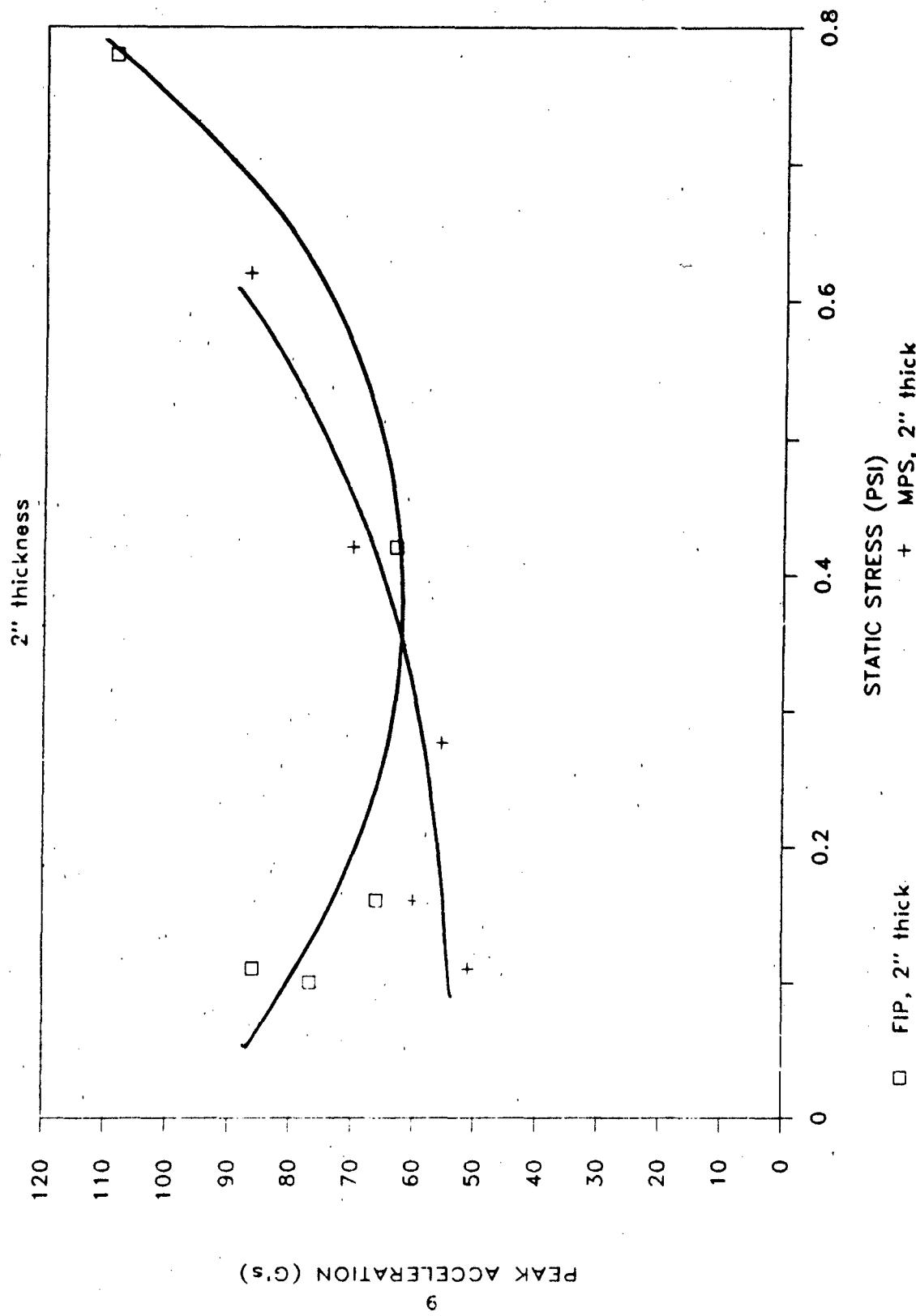
Exposure to high humidity conditions (90 percent RH) will cause MPS to be 10-15 percent less effective as compared to performance at normal room conditions (50 percent RH). This was attributed to the failure of the latex bonding mechanism.

GRAPH 1, PEAK G - STATIC STRESS CURVE

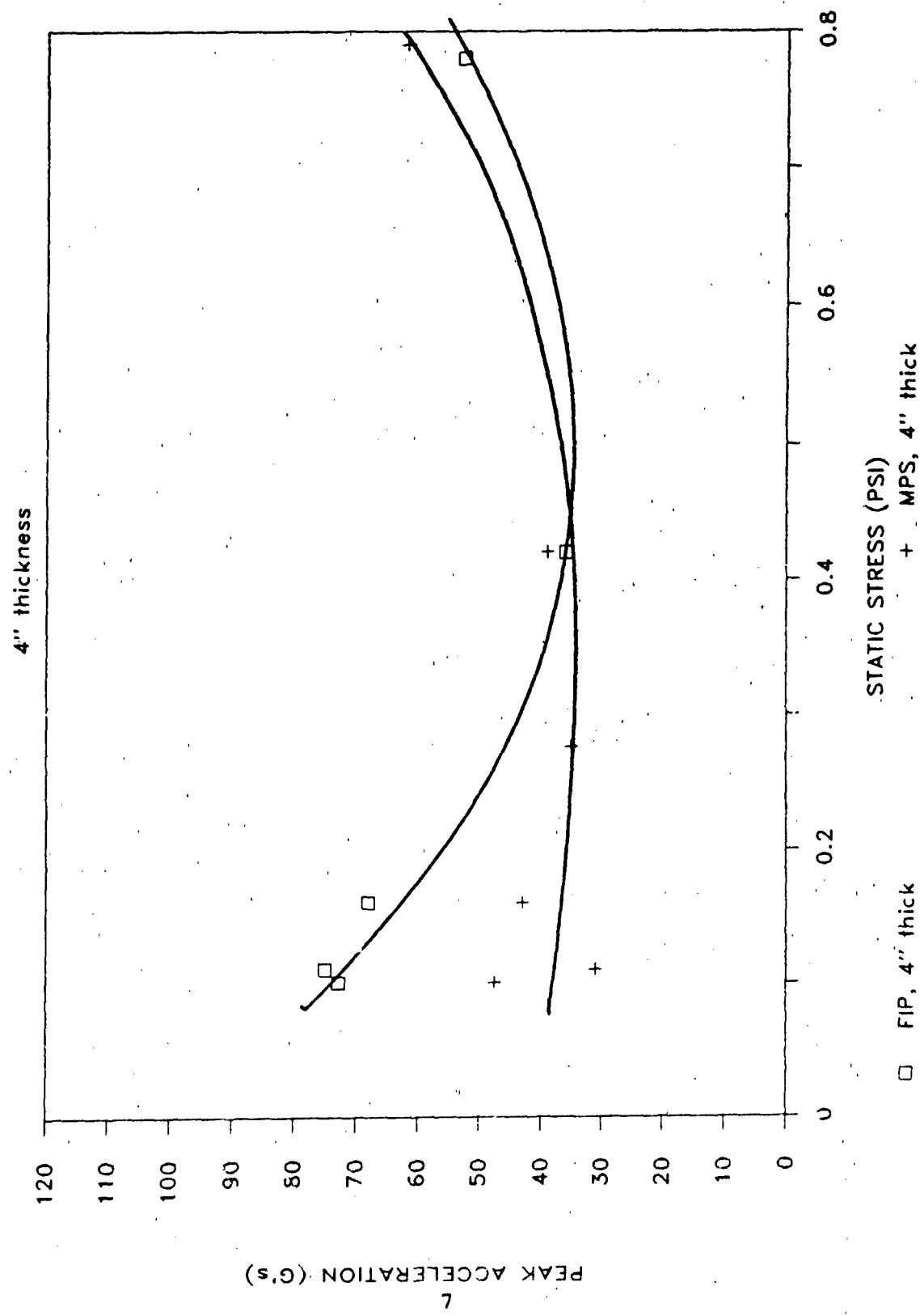
FOAM-IN-PLACE, CLASS 2, GRADE B



GRAPH 2, FIP vs. PELESPAN MOLD-A-PACK

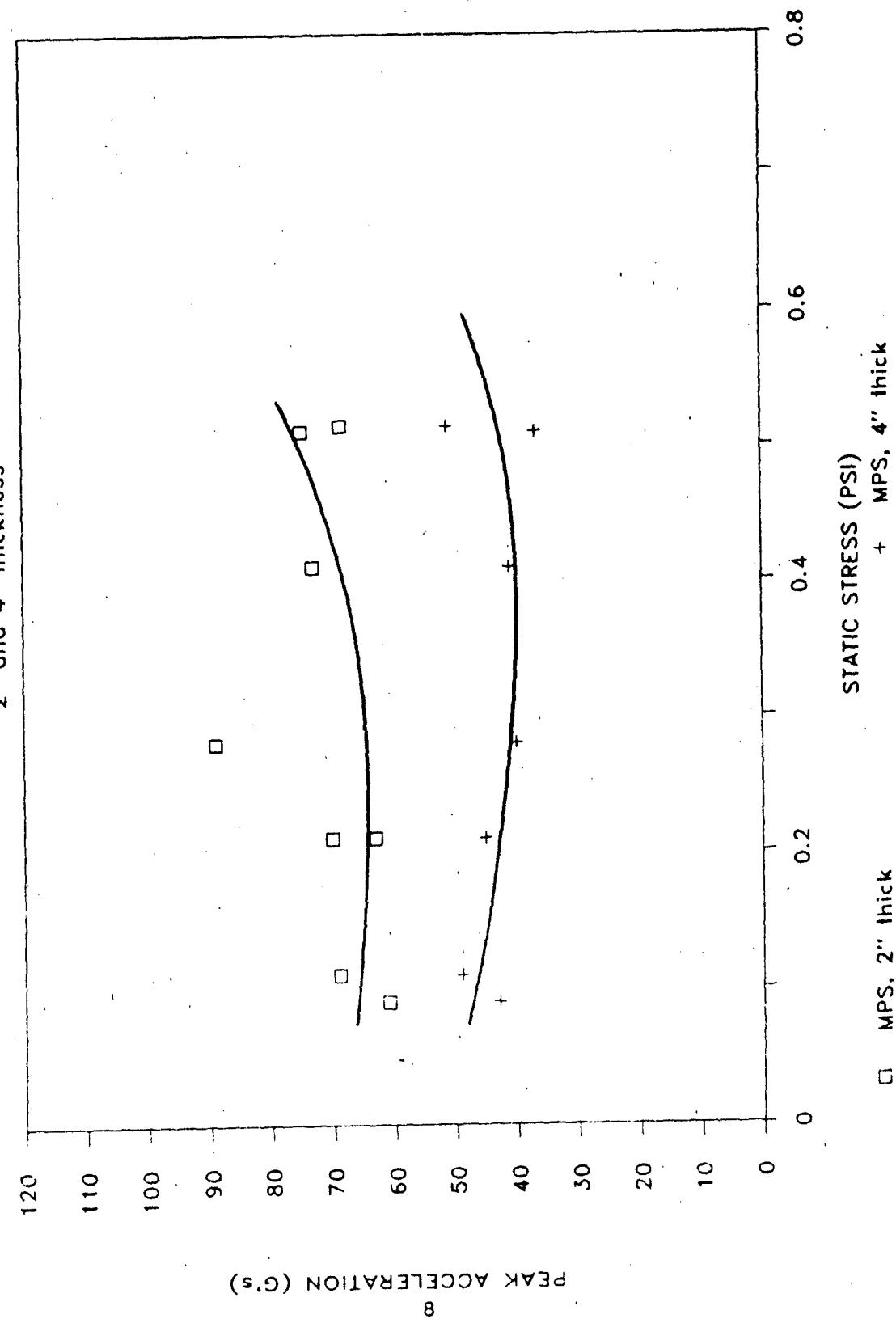


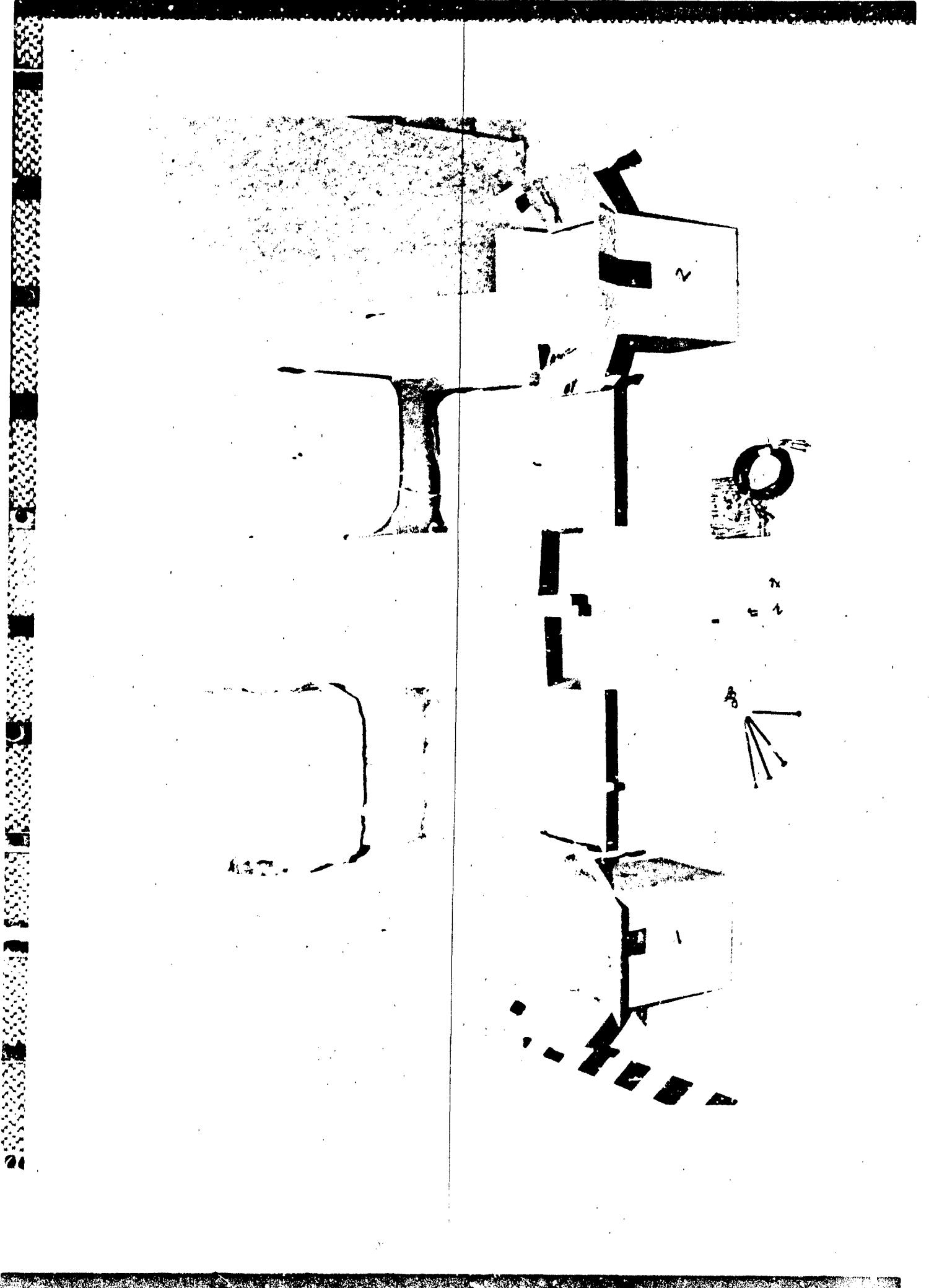
GRAPH 3, FIP vs. PELESPAN MOLD-A-PACK

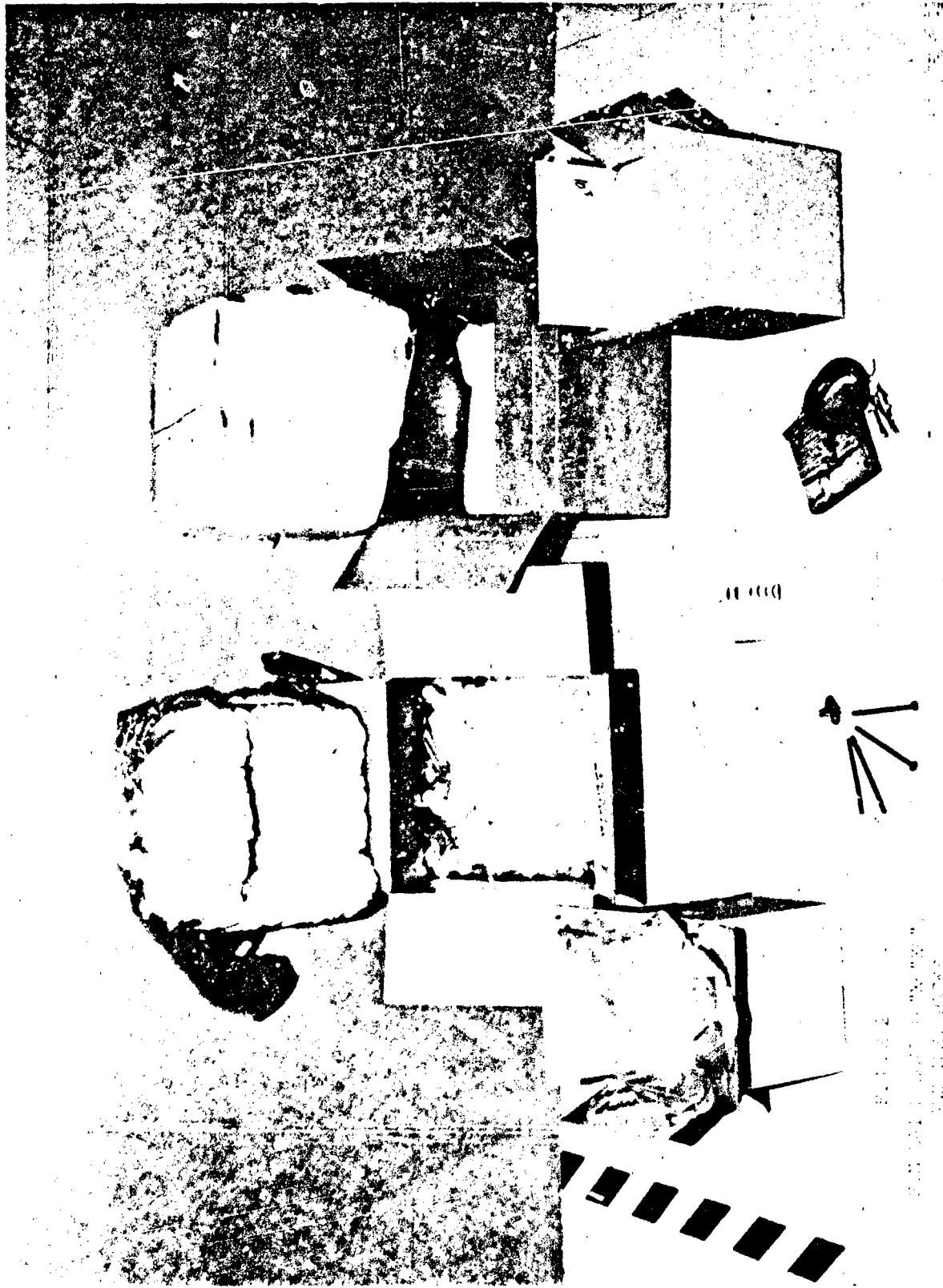


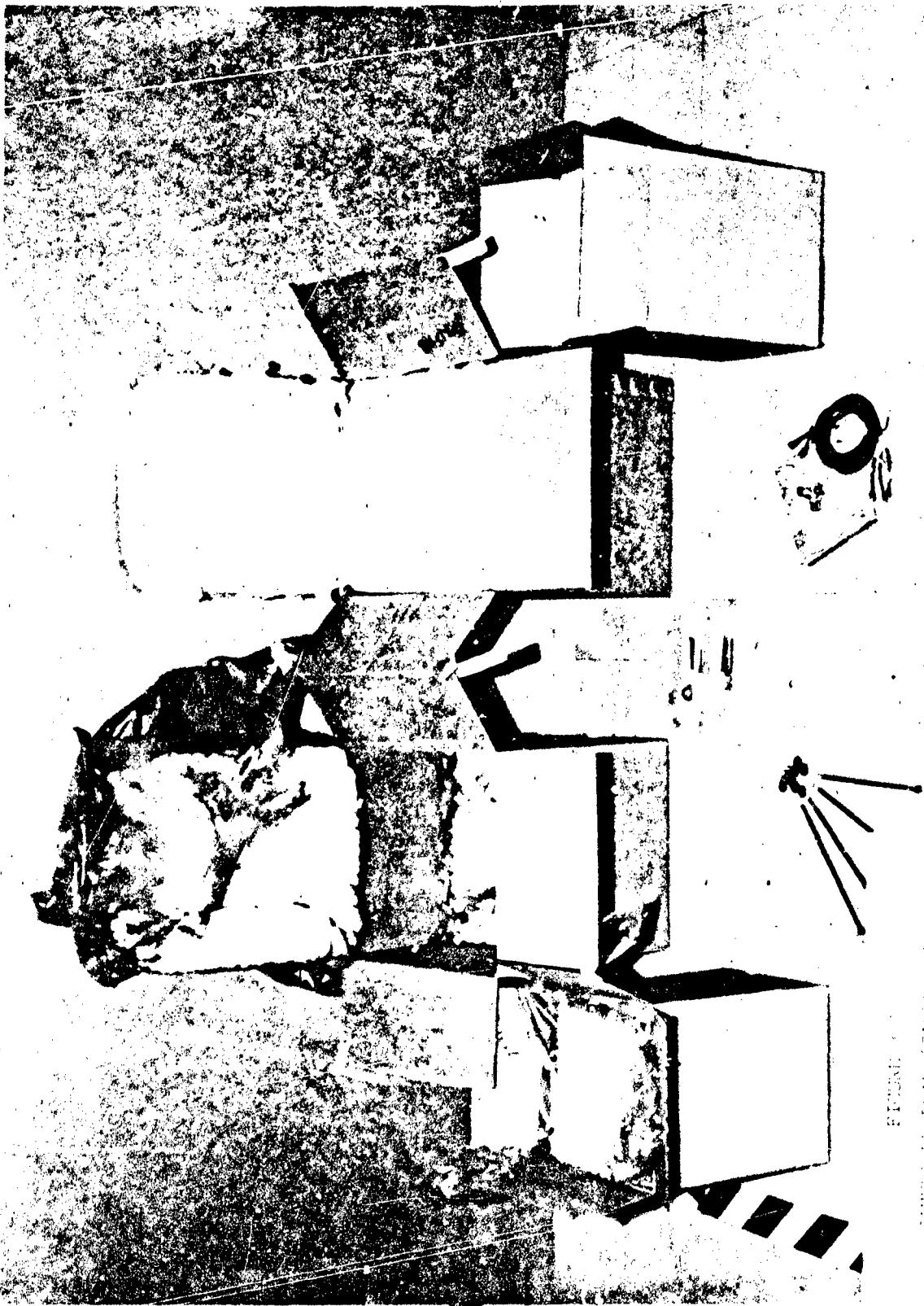
GRAPH 4, PELESPAN MOLD-A-PACK at 90%RH

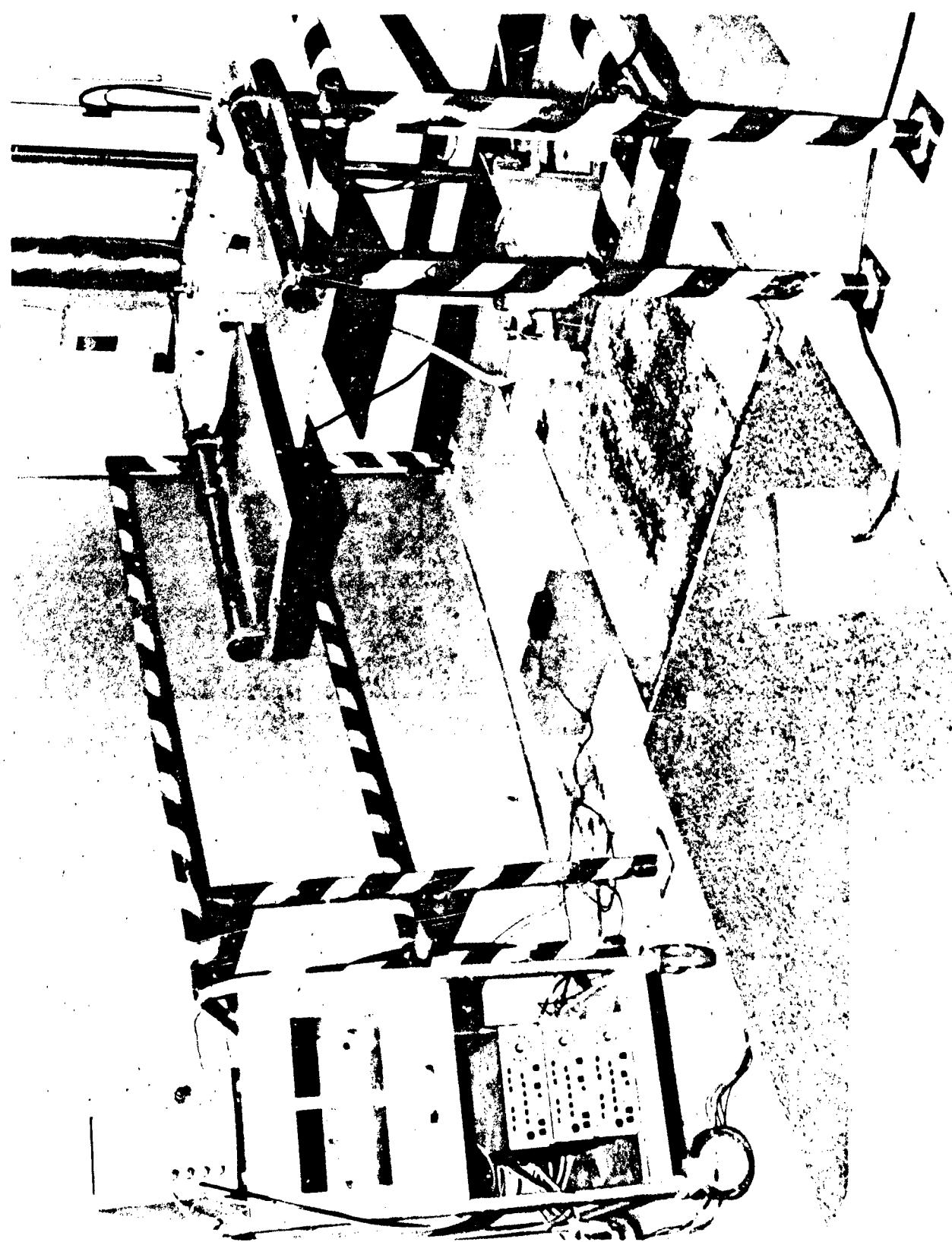
2" and 4" thickness











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